A Record of the Gold-tipped Bat from the Escarpment Forests of Southern New South Wales

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The Golden-tipped Bat *Kerivoula papuensis* is a distinctive and infrequently encountered microchiropteran species which is known from isolated records from Papua New Guinea, eastern Queensland and eastern New South Wales as far south as the Bega region (Lunney *et al.* 1986; Flannery 1990; Strahan 1992). Most records are from northeastern New South Wales and result from a significant increase in fauna survey in that region during the past three years. The species is unusual in that orb-spiders appear to comprise a substantial component of its diet (Hall and Woodside 1989). It was thought to be a rainforest specialist (Richards 1983), although Lunney *et al.* (1986) trapped it at three sites in dry eucalypt forest and a small proportion of more recent records are also from sites in dry eucalypt forest (Schulz 1994, unpubl. data).

We report the fourth record of this species from the southern extreme of its range, and discuss this site in terms of previous predictions of the species' distribution by Walton *et al.* (1992).

In Papua New Guinea the species has been recorded from very few individuals over less than half a dozen scattered localities and it is regarded as rare (Flannery 1990). Until recently, the species was known from very few localities in Australia and its status is variously considered as rare (Strahan 1992; Richards 1992) or uncommon and localized (Parnaby 1992). For example, by 1984 the species was known from only 11 sites and 15 individuals in Australia (Parnaby 1984), while Barker *et al.* (1994) noted that an individual captured during their survey in 1989 was only the 21st individual recorded. In New South Wales, the species is categorised as Vulnerable and Rare on the Schedule 12 (endangered species list) of the *National Parks and Wildlife Act* 1974, as amended by the *Endangered Fauna (Interim Protection) Act* 1991.

Walton *et al.* (1992) record the species from 11 localities in eastern Australia, three of which are from New South Wales. Since then there has been a significant increase in the number of locality records and numbers of trapped individuals of this species and several dozen additional sites are known from northern New South Wales. These records result from an intensive bat trapping programme undertaken as part of the NSW National Parks and Wildlife Service North East Forest Biodiversity Study, and a number of fauna surveys undertaken during faunal impact studies. Most records are from rainforest sites or sclerophyll forest adjacent to rainforest, but a small number of sites were in dry sclerophyll forest without rainforest in the general area (NSW NPWS North East Forest Biodiversity Study database). Schulz (1994) reported the capture of a further 92 individuals at ten localities between Kroombit Tops, central Queensland, and Woolgoolga, northern New South Wales. We are aware of the capture of only three individuals south of Sydney (Lunney *et al.* 1986). These are the southern-most records

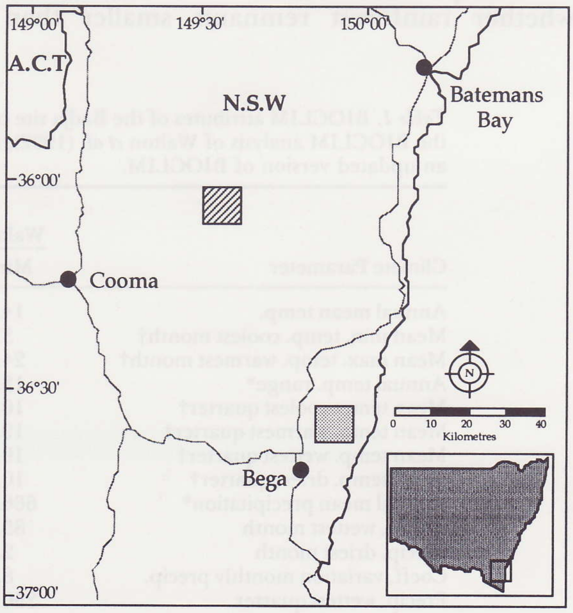

Figure 1. Location of study area where *Kerivoula papuensis* was trapped (cross-hatched box). Previously recorded occurrences of *K. papuensis* south of Sydney (Lunney and Barker 1986) denoted by stippled box. Inset shows location of study region in New South Wales.

of this species. In this paper we report a new record for southeastern New South Wales, captured during a trapping and bat call survey of a coast escarpment transect in the Batemans Bay region, on the south coast of New South Wales. It was an adult female with a forearm length of 36.0 mm, weighed 6.5 gms, and had rudimentary, regressed nipples. It has been lodged in the Australian Museum collection. It was captured in a harp trap on 10 March, 1994 in Badja State Forest (36°06'30"S, 149°35'00"E, see Fig. 1) at an altitude of 1 000 m (± 50 m). The site is 50 km from the coast and is within approximately 2 km from the edge of the escarpment. The trap was located on a vehicle track in a thick stand of young eucalypt regrowth on a slope with a westerly aspect. The surrounding forest was predominantly dry sclerophyll forest, with wet sclerophyll elements in the understorey.

Although nothing is known of the movements of this species, it is possible that the Badja individual could have moved some distance from a rainforest remnant in a gully below the escarpment. The occurrence of rainforest in the escarpment around the Badja site was examined by Landsat TM imagery, with a resolution of 200 × 200 m. The predominant forest type within 4 km of the Badja site was dry forest dominant over moist forest. A 20 ha patch of rainforest was detected 10 km south-west of the site (i.e., on the tableland), but there were no rainforest patches of detectable size in the immediate vicinity below the escarpment. We were unable to establish whether rainforest remnants smaller than the Landsat resolution occurred within approximately 1 km of the site. However, as a mosaic of wet sclerophyll forest patches in predominantly dry eucalypt forest occurred within a 5 km radius of the site, the presence of rainforest cannot be discounted.

Walton *et al.* (1992) used BIOCLIM (Busby 1991) to model the distribution of this species based on 11 locality records from Queensland and New South Wales, using 16 bioclimatic parameters of rainfall and temperature. They considered that the most significant predictive variable in their analysis was a narrow temperature range between mean winter minima and mean summer maxima, which was amongst the lowest 10 per cent of ranges in Australia. Two other correlates which they considered important were comparatively high values for mean annual precipitation, and precipitation of the warmest quarter. They predicated that the southern Australian distribution of this species will be limited to a narrow coastal zone with subtropical and warm temperate climates, such as in subtropical forest in deep coastal valleys.

A climatic profile of the Badja site was generated using an updated version of BIOCLIM and the 16 parameters used by Walton *et al.* (1992). The updated version employs a gridded digital elevation model (DEM) with a significantly increased horizontal resolution (i.e., 1/40 degree of 2.5 km cells compared with 0.5 degree and 50 km cells) and upgraded climatic data. Due to the improvements in the BIOCLIM data sets we compared the original bioclimatic envelope

Table 1. BIOCLIM attributes of the Badja site compared to the maximum and minimum values from the BIOCLIM analysis of Walton *et al.* (1992), and values from the reanalysis of their site data using an updated version of BIOCLIM.

Climate Parameter	Walton *et al.* (1992) Min.	Walton *et al.* (1992) Max.	Reanalysis of Walton *et al.* (1992) Min.	Reanalysis of Walton *et al.* (1992) Max.	Badja Site
Annual mean temp.	14.7	25.7	14.48	25.67	10.25
Mean min. temp. coolest month†	3.7	18.6	2.45	18.62	−1.67
Mean max. temp. warmest month†	24.3	34.1	24.90	34.06	23.40
Annual temp. range*	13.1	26.7	13.37	26.76	25.06
Mean temp. coolest quarter†	10.2	23.1	9.69	23.07	4.31
Mean temp. warmest quarter†	19.1	27.8	19.17	27.77	15.88
Mean temp. wettest quarter†	19.1	27.4	18.05	27.37	15.73
Mean temp. driest quarter†	10.8	24.7	10.30	24.73	5.19
Annual mean precipitation*	666.0	1 951.0	666.20	2 349.31	843.25
Precip. wettest month	85.0	468.0	80.94	548.93	96.26
Precip. driest month	2.0	75.0	0.00	87.24	47.56
Coeff. variation monthly precip.	8.0	121.0	20.72	118.58	18.43
Precip. wettest quarter	250.0	1 218.0	239.97	1 390.38	255.39
Precip. driest quarter	9.0	240.0	0.00	267.42	162.76
Precip. coolest quarter	15.0	345.0	15.54	399.37	182.45
Precip. warmest quarter†*	250.0	730.0	239.97	734.83	232.44

*denotes the three most important indicators identified by Walton *et al.* (1992).
†denotes Badja site attributes outside the range.

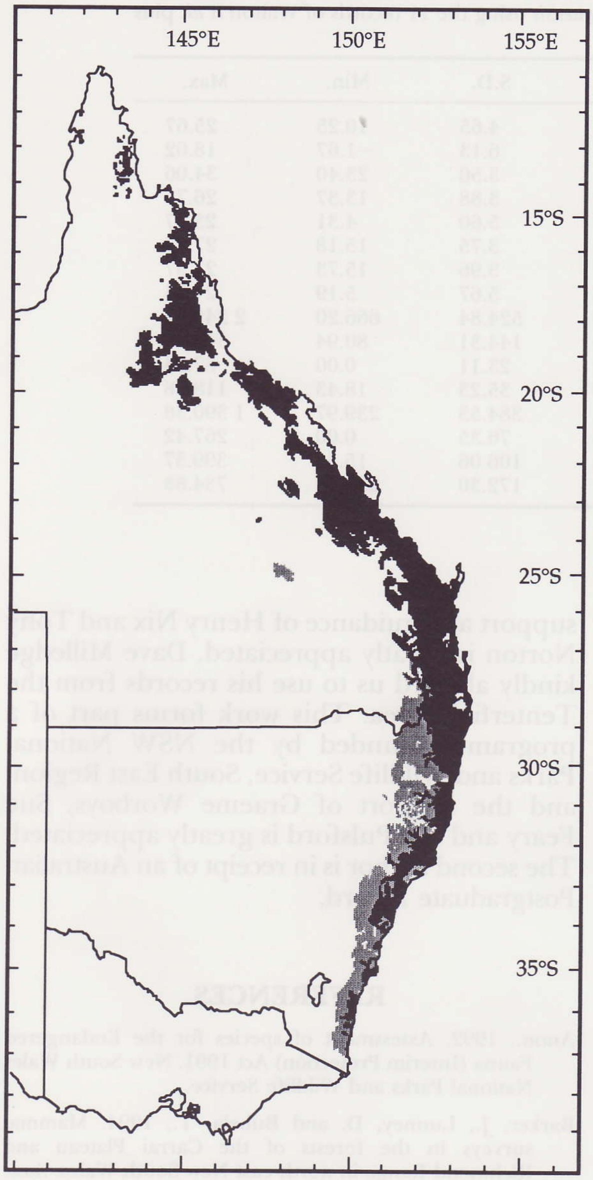

Figure 2. Predicted BIOCLIM distribution of *Kerivoula papuensis.* Black area is derived from the 11 capture localities of Walton *et al.* (1992). Stippled area is the range extension with the addition of the Badja record to the BIOCLIM analysis.

derived by Walton *et al.* (1992) to one derived using the new DEM and climate data, using the original 11 sites available to Walton *et al.* (1992). The Badja site falls outside the range in values for seven attributes, including precipitation of the warmest quarter, but falls within the range for two attributes considered important predictors by Walton *et al.*, i.e., annual temperature range and annual mean precipitation (see Table 1).

The Badja capture is one of the highest elevation records of *K. papuensis,* both in Australia and Papua New Guinea. The occurrence of this species at such a high elevation in the southern geographic extreme of its distribution was unexpected and contrasts with the southern distribution predicted by Walton *et al.* (1992). They suggested that the species is most likely to occur in low elevation lowland rainforests. The highest elevation record appears to be 1 210 m from Mt Karimui, in the Highlands of Papua New Guinea (Flannery 1990). The highest elevation cited in Walton *et al.* was at 780 m in the Atherton Tablelands. That record was from a harp trap placed in a dry creek bed in dry open forest (H. Parnaby, pers. obs.). The highest elevation Australia record of which we are aware, is a warm temperate rainforest site at 1 050 m in Forest Lands State Forest, south-east of Tenterfield, northern New South Wales (David Milledge, pers. comm.). This locality is on the top of the Great Dividing Range, and appears to be the most inland record of this species from New South Wales. As with the Badja site, bioclimatic attributes of this site generated using BIOCLIM fall within the predicted range for the three principle distributional correlates identified by Walton *et al.* (1992).

The broad predicted distribution of *K. papuensis* was examined with an updated version of BIOCLIM using the same parameters and localities as Walton *et al.* and compared with further analysis which included the Badja site. Range in values of the bioclimatic attributes using the original 11 localities are similar to those of the original analysis of Walton *et al.* (1992) but estimated minimum values are lower for seven attributes (see Table 1). The predicted distribution is similar to that of Walton *et al.*, except that it encompasses two previous discontinuities, one in northern New South Wales south of 30° latitude, the other at about 35° South (Fig. 1). A further analysis which included the Badja site produced lower minima for seven attributes (see Table 2), including precipitation of the warmest quarter. The resulting predicted distribution for most of Queensland closely approximates that based on the 11 original sites. However, it is substantially increased at latitudes south of about 28°S, in southern Queensland and particularly in southern New South Wales (see Fig. 2). The predicted distribution extends only marginally further south than that derived without the Badja site.

Lunney *et al.* (1986) trapped *K. papuensis* at three sites in Mumbulla State Forest, all of which were in dry eucalypt forest with a complex logging history (Lunney and Moon 1988). Three individuals were obtained during some 1 300 bat trap nights over several years (Lunney *et al.* 1988). Although the area

Table 2. Updated BIOCLIM profile for *Kerivoula papuensis* using the 11 records of Walton *et al.* plus the Badja site.

Climate Parameter	Mean	S.D.	Min.	Max.
Annual mean temp.	20.40	4.65	10.25	25.67
Mean min. temp. coolest month	9.65	6.13	−1.67	18.62
Mean max. temp. warmest month	29.53	3.50	23.40	34.06
Annual temp. range	19.88	3.88	13.37	26.76
Mean temp. coolest quarter	16.14	5.60	4.31	23.07
Mean temp. warmest quarter	24.04	3.75	15.18	27.77
Mean temp. wettest quarter	23.42	3.96	15.73	27.37
Mean temp. driest quarter	17.59	5.67	5.19	24.73
Annual mean precipitation	1 344.02	524.84	666.20	2 349.31
Precip. wettest month	253.05	144.31	80.94	548.93
Precip. driest month	33.82	23.11	0.00	87.24
Coeff. variation monthly precip.	68.39	35.23	18.43	118.58
Precip. wettest quarter	705.21	384.53	239.97	1 390.38
Precip. driest quarter	118.38	76.35	0.00	267.42
Precip. coolest quarter	155.08	106.06	15.54	399.37
Precip. warmest quarter	489.07	172.30	232.44	734.83

was predominantly dry eucalypt forest, small isolated strips of rainforest occur in gullies in the area, none of which were trapped during their survey although the gullies and creeks containing these dry rainforest elements were trapped (D. Lunney, pers. comm.). Until information is obtained about the roost ecology and movements of this species, the significance of records in dry eucalypt forest, the relevance of rainforest gullies, and the potential impacts of logging operations on this species, cannot be evaluated.

The status of the species as endangered (Vulnerable and Rare) on Schedule 12 in New South Wales is based on a consideration of the suspected historical reduction in the species range as a result of habitat destruction such as extensive clearing of coastal forest, the impacts of severe threatening processes, and because it is an ecological specialist (Anon 1992). The recent increase in locality records do not alter this evaluation, and its continued status as an endangered species with a Vulnerable and Rare listing is therefore justified.

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BOOK REVIEWS — BOOK REVIEWS

"Australia's Conservation Reserves" by J. Coveny. 1993.
Cambridge University Press, Melbourne.
114 pp. ISBN 0 521 42703 7. $19.95.

The Australiana and Natural History sections of bookshops are replete with books on national parks, ranging from lavish coffee table presentations to detailed guides for the serious bushwalker. "Australia's Conservation Reserves" is from a very different genre and has few rivals in the market. It is aimed at senior high school students, most probably in geography classes but it will also be relevant in biology, environmental and rural sciences and general studies. It will also be of interest to a wider audience of conservationists and environmentalists and should be available in all public libraries.

The book is well designed and, by current standards, very reasonably priced. Although illustrated with numerous appropriate photographs the reproduction is unfortunately typical of that in many academic publications (even very expensive ones), with many lacking clarity and contrast. Despite the many technological advances in book production in recent years reproduction of plates is one area where standards appear to have declined. To get a better impression of the scenic majesty of many of our national parks it will still be necessary to consult some of the better coffee table books.

Within the constraints of a short book for schools the author has done a remarkable job, introducing a wide range of topics. It should certainly act as a stimulus for classroom discussion (and to further encourage debate a series of questions are provided in each chapter).

The book is about reserves and is not a general introduction to conservation biology. Nevertheless the term "reserve" is interpreted broadly. It is gratifying to see a chapter devoted to *Marine Parks* as many overviews of conservation are written from a strictly terrestrial standpoint. Inclusion of a section on urban bushland is also of great value given the many opportunities for discussion of local management issues this will provide. Eyebrows might be raised, however, by a chapter entitled *Forest Reserves* which discusses not flora reserves within state forests but the conservation values of production forests. While concentrating upon case studies of conflict between forestry and other land use, the chapter also makes the point that all forests have habitat value and through multiple use management can make an important contribution to conservation (although the opportunity to explore the conflicts generated by different interpretations of the term multiple use is not fully grasped). Curiously, however, the concept of old growth forests is not mentioned. Despite this admirably broad use of reserve, the main thrust is on national parks, for which the IUCN definition is adopted. The full list of IUCN categories is not presented and this is unfortunate given discussion of the desirability of the adoption of more uniform terminology in conformity with the IUCN categories in several recent reports and the continuing pressure from industry groups for the reclassification of most Australian reserves to IUCN category IV (i.e., multiple use) rather than their current categories I and II status (in which nature conservation is the pre-eminent objective). Given that nature does not appear in the books title greater emphasis could have been given to the part conservation reserves may play in cultural heritage conservation and the management conflicts which might arise from single agencies having both cultural and natural heritage obligations.

The background information on Australia's wildlife and the justification for conservation are provided in brief introductory chapters. Although sympathizing with the authors difficult task of summarizing a wealth of information in a very short space I feel these are the least successful part of the book. Not only are there several unfortunate errors, but the passion which has characterized